Remarks/Arguments

With reference to the Office Action mailed May 18, 2006, Applicants offer the following remarks and argument.

Status of the Claims

Claims 1-14 were originally presented for examination. All of the claims were rejected. Applicants have amended their claims to distinguish their claimed invention over the art of record. Support for the amended claims is found in numbered paragraphs [0024] through [0027] and [0030].

The Art of Record

The primary reference, United States Patent 4,761,253 to Gregor Antes for Method And Apparatus For Producing A Relief Pattern With A Microscopic Structure, In Particular Having An Optical Diffraction Effect describes a method and apparatus for embossing a pattern having a microscopic relief structure. By way of example, the pattern could be embossed to form an optical diffraction grating, onto a layer of thermoplastic material is disclosed. A small circular region of a flexible embossing die is pressed against the thermoplastic layer by means of a punch. A fraction of the corresponding small circular region of the thermoplastic layer is then heated from the rear by a beam of radiant energy. The process may be repeated at all points on the thermoplastic layer where the pattern is desired.

The passages in Antes cited in the Office Action include:

1. Lines 5-11 of the Summary of the Invention:

> It is an object of this invention to provide a method of, and apparatus for, producing a relief pattern with a microscopic structure by selecting small surface regions of an embossing die, having a microstructure, and embossing them on a

correspondingly small region of a thermoplastic medium by applying sharply localized heat and pressure to the thermoplastic material.

2. Column 5, lines 1-13:

> As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.
>
> It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

United States Patent 3,866,187 to Dougherty et al. for Method Of Recording And Reproducing Information In Ferroelastic Metals describes a method and system where information is stored in a thin film of a ferroelastic metal. This is accomplished by initially deforming the metal film to a state of stable remanent strain, e.g., by an air jet, stylus, or electrostatic repulsion, or attraction and thereafter locally heating the metal film above its ferroelastic transition temperature to remove the remanent strain and restore those portions of the film to their prestrained condition. Dougherty et al. disclose information can be stored on the metal film (in a pattern of deformed and undeformed regions) by using the local heating means responsive to a source of information. The information can be subsequently readout by optically, or electrically interrogating the metal film. This technique provides a method for achieving a high density information storage system with read-write-erase capability.

The passages in Dougherty et al that were cited in the Office Action include:

1. The Abstract;

> Information is stored in a thin film of a ferroelastic metal by initially deforming the metal film to a state of stable remanent strain, e.g., by an air jet, stylus, or electrostatic repulsion, or attraction and thereafter locally heating the metal film above its ferroelastic transition temperature to remove the remanent strain therein

and restore those portions of the film to their prestrained condition. Thus, information can be stored on the metal film (in a pattern of deformed and undeformed regions) by using the local heating means responsive to a source of information. The information can be subsequently readout by optically, or electrically interrogating the metal film. This technique provides a method for achieving a high density information storage system with read-write-erase capability.

2. Column 1, lines 35-39:

> We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Additionally, United States Patent 5,329,122 to Sakai et al for Information Processing Apparatus And Scanning Tunnel Microscope describes an information processing apparatus for recording information on and/or reproduction of information from a recording medium with a probe electrode, a cantilever piezo-electric member, a controller and a detector. The probe electrode is displaced relative to the recording medium by the cantilever piezo-electric member. The controller applies a control signal to the cantilever piezo-electric member to control the cantilever piezo-electric member. The detector detects a minute signal obtained on the tunnel effect caused between the probe electrode and the recording medium. A switch element is further provided on the apparatus so as to electrically disconnect between the cantilever piezo-electric member and the controller during the minute signal being detected by the detector.

The cited passage in Sakai et al. is Column 7, lines 49-65, and lines 65-66:

> In this state, SW is closed instead of SR being closed (recording). SW is specifically connected to a bias voltage source of +6 V, and as long as SW is ON, a pulse of a crest value +6 V is applied to between the probe and the recording medium. XY scanning is awaited and at a point of time whereat the probe has been returned to the location at which the application of the pulse has been effected, the detected probe current has momentarily increased to about 0.1 .mu.A. It is read that the detected current at the recording position has increased two-fold (reproduction). Further, when XY scanning is again effected and the

probe arrives at the recording bit position, SE is closed instead of SR, whereby a pulse of a crest value -4 V is applied (erased) to the recording medium, whereupon the probe current detected thereafter at such position restores 1nA. The above-described recording/reproduction/erasing can be repeated stably.

The fourth reference, United States Patent 4,599,718 to Nakagawa et al. for Method For Erasing A Light Recording Medium, describes a method for erasing a light recording medium comprising a thermoplastic resin having a number average molecular weight of 30,000 or less wherein a recording pit is refilled by using a light beam diameter greater than the pit diameter.

The cited portions of Nakagawa et al. include:

1. Column 2, lines 18-34:

Its second object is to provide such an erasable light recording medium, in which a distinguishable threshold value appears in the light recording layer, thereby a pit is formed always with good reproducibility at a level of the predetermined input energy or higher, while at an energy level below the predetermined value, no pit is formed, thereby the region of the input light or temperature in which reproducibility of the pit formation fluctuates is narrowed, and in which at the same time the heat resistance is high and hence the deterioration in the S/N ratio of the information signal written in the pit during storage at high temperature is reduced, the surface of the pit or its vicinity does not undergo deformation due to the reading light, the S/N ratio of the written information signal is not deteriorated, further the writing sensitivity is high, and still further the S/N ratio of reading is extremely high.

2. Column 4, lines 20-26:

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

The Office Action of May 18, 2006

The claims were rejected as unpatentable over Antes, United States Patent 4,761,253 with Method And Apparatus For Producing A Relief Pattern With A Microscopic Structure, In Particular Having An Optical Diffraction Effect taken with United States Patent 3,866,187 to Dougherty et al. for Method Of Recording And Reproducing Information In Ferroelastic Metals, and with United States Patent 5,329,122 to Sakai et al for Information Processing Apparatus And Scanning Tunnel Microscope, and with United States Patent 4,599,718 to Nakagawa et al. for Method For Erasing A Light Recording Medium. These references are applied to the original claims as follows:

1.

A method for erasing data recorded in a data storage device in which a data bit is written onto a surface by applying a first combination of energy and force to the surface via a tip to form a pit in the surface representative of the data bit by local deformation of the surface, the method comprising applying a second combination of energy and force via the tip to prerecorded pits of the surface to be erased, the second combination being different to the first combination, and forming new pits overlapping pits representative of prerecorded data to be erased to substantially level the surface.

Antes, Column 5, lines 1-13:

> As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.
>
> It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

> We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

2.

A method as claimed in claim 1, wherein the force applied in the first combination is greater than the force applied in the second combination.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Sakai, Column 7, lines 49-65, and lines 65-66:

In this state, SW is closed instead of SR being closed (recording). SW is specifically connected to a bias voltage source of +6 V, and as long as SW is ON, a pulse of a crest value +6 V is applied to between the probe and the recording medium. XY scanning is awaited and at a point of time whereat the probe has been returned to the location at which the application of the pulse has been effected, the detected probe current has momentarily increased to about 0.1 .mu.A. It is read that the detected current at the recording position has increased two-fold (reproduction). Further, when XY scanning is again effected and the probe arrives at the recording bit position, SE is closed instead of SR, whereby a pulse of a crest value -4 V is applied (erased) to the recording medium, whereupon the probe current detected thereafter at such position restores 1nA. The above-described recording/reproduction/erasing can be repeated stably.

3.

A method as claimed in claim 2, wherein the energy applied in the first combination is greater than the energy applied in the second combination.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

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4.

A method as claimed claim 1 wherein the energy applied in the first and second combinations comprises heat.

Antes, Lines 5-11 of the Summary of the Invention:

It is an object of this invention to provide a method of, and apparatus for, producing a relief pattern with a microscopic structure by selecting small surface regions of an embossing die, having a microstructure, and embossing them on a correspondingly small region of a thermoplastic medium by applying sharply localized heat and pressure to the thermoplastic material.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

5.

A method as claimed in claim 1, wherein the forming of the new pits comprises offsetting the new pits relative to the deformations representative of the prerecorded data to be erased.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Nakagawa, Column 4, lines 20-26:

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

6.

A method as claimed in claim 5, wherein the forming of the new pits comprises forming a line of new pits in which each pit overlaps the immediately preceding pit.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Nakagawa, Column 4, lines 20-26:

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

7.

A data processing system comprising: a data storage surface; a tip in contact with the surface and moveable relative thereto; and a controller operable, in a write mode, to apply a first combination of energy and force to the surface via a tip to form a pit in the surface representative of the data bit by local deformation of the surface and, in an erase mode, to apply a second combination of energy and force via the tip to prerecorded pits of the surface to be erased, the second combination being different to the first combination, and to control the tip to form new pits overlapping pits representative of prerecorded data to be erased to substantially level the surface.

Antes, Column 5, lines 1-13:

> As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.
>
> It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

> We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Nakagawa, Column 4, lines 20-26:

> Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

8.

A system as claimed in claim 7, wherein the force applied in the first combination is greater than the force applied in the second combination.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

9.

A system as claimed in claim 8, wherein the energy applied in the first combination is greater than the energy applied in the second combination.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Sakai, Column 7, lines 49-65, and lines 65-66:

In this state, SW is closed instead of SR being closed (recording). SW is specifically connected to a bias voltage source of +6 V, and as long as SW is ON, a pulse of a crest value +6 V is applied to between the probe and the recording medium. XY scanning is awaited and at a point of time whereat the probe has been returned to the location at which the application of the pulse has been effected, the detected probe current has momentarily increased to about 0.1 .mu.A. It is read that the detected current at the recording position has increased two-fold (reproduction). Further, when XY scanning is again effected and the probe arrives at the recording bit position, SE is closed instead of SR, whereby a pulse of a crest value -4 V is applied (erased) to the recording medium, whereupon the probe current detected thereafter at such position restores 1nA. The above-described recording/reproduction/erasing can be repeated stably.

10.

A system as claimed in claim 8, wherein the energy applied in the first and second combinations comprises heat.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Sakai, Column 7, lines 49-65, and lines 65-66:

In this state, SW is closed instead of SR being closed (recording). SW is specifically connected to a bias voltage source of +6 V, and as long as SW is ON, a pulse of a crest value +6 V is applied to between the probe and the recording medium. XY scanning is awaited and at a point of time whereat the probe has been returned to the location at which the application of the pulse has been effected, the detected probe current has momentarily increased to about 0.1 .mu.A. It is read that the detected current at the recording position has increased two-fold (reproduction). Further, when XY scanning is again effected and the probe arrives at the recording bit position, SE is closed instead of SR, whereby a pulse of a crest value -4 V is applied (erased) to the recording medium, whereupon the probe current detected thereafter at such position restores 1nA. The above-described recording/reproduction/erasing can be repeated stably.

11.

A system as claimed in claim 1, wherein the controller is operable to control offset of the new pits relative to the deformations representative of the prerecorded data to be erased.

Antes, Lines 5-11 of the Summary of the Invention:

It is an object of this invention to provide a method of, and apparatus for, producing a relief pattern with a microscopic structure by selecting small surface regions of an embossing die, having a microstructure, and embossing them on a correspondingly small region of a thermoplastic medium by applying sharply localized heat and pressure to the thermoplastic material.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

12.

A system as claimed in claim 11, wherein the controller is to operable to control to the tip to form a line of new pits in which each pit overlaps the immediately preceding pit.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Nakagawa, Column 4, lines 20-26:

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

13.

A system as claimed in claim 12, wherein the controller is operable to control offset the new pits relative to the deformations representative of the prerecorded data to be erased.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Nakagawa, Column 4, lines 20-26:

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

14.

A system as claimed in claim 13, wherein the controller to operable to control to the tip to form a line of new pits in which each pit overlaps the immediately preceding pit.

Antes, Column 5, lines 1-13:

As shown in FIG. 4, a structure which has been produced can be freshly written over. The old structure is erased if the energy density of the beam is at a sufficiently high level. This simplifies the production of complex structures as, in a first writing operation, it is not necessary to avoid those surface areas which are to be covered with another structure in a subsequent second writing operation.

It is also possible, by precise quantitative control of the energy density of the beam 13 and the speed of writing, for a new structure to be embossed over an old structure, without the old structure being completely erased.

Dougherty, Column 1, lines 35-39:

We have conceived of a technique for recording, reading and erasing information in small areas (10^{-4} to 10^{-2} cm^2) using materials which exhibit a reversible elastic transition. The ferroelastic metals previously described are one example of such a material.

Nakagawa, Column 4, lines 20-26:

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again.

Applicants' Claimed Invention

At a high level Applicants' claims are directed to a method, system, and program product for erasing data that has been recorded in a data storage device where data is store in pits in a thermally deformable material. A data bit is written onto a surface by applying a first combination of energy and force to the surface via a tip to form a pit in the surface representative of the data bit by local deformation of the surface. The claims recite applying a second combination of energy and force via the tip to prerecorded deformations (bits) of the surface which are to be erased. Erasure is accomplished by substantially leveling the surface.

Discussion

The overarching issue presented is that Applicants' amended claims impart allowability to the amended claims.

Amended claim 1 is illustrative:

> 1. (Currently Amended) A method for erasing data recorded in a data storage device in which a data bit is originally written onto a polymeric surface carried by a silicon substrate by applying a first combination of heat energy and mechanical force to the polymeric surface via a tip to form a pit in the surface representative of the data bit by local deformation of the polymeric surface, the method comprising applying a write current to the tip to heat the tip to a temperature of the order of 700 degrees centigrade level sufficient to locally deform the polymer layer thereby causing the tip to indent the surface of the polymer layer and leave a pit of a diameter of about 40 nm and surrounded by a ring of polymer substrate material raised above the polymer layer and applying a second combination of energy and mechanical force via the tip to prerecorded pits of the polymeric surface to be erased, the second combination being different to the first combination, and forming new pits overlapping pits representative of prerecorded data to be erased to substantially level the polymeric surface by performing the write operation to overwrite pits to be erased with a greater

density of new pits overlapping each other so that each new pit erases the immediately preceding pit, the overlapping new pits merging with each other and the pre-recorded pit to be erased to substantially level the polymer surface to a level where the erased, pre-recorded bit is not detected as a data bit during a read operation.

The amendments to claims 1 and 7 add the following elements to the claims:

1. The device structurally comprises a polymeric surface carried by a silicon substrate

2. Data is written by applying a first combination of heat energy and mechanical force to the polymeric surface.

3. This forms a pit in the surface representative of the data bit by local deformation of the polymeric surface.

4. The method comprises applying a write current to the tip to heat the tip to a temperature of the order of 700 degrees centigrade level

   a. This is recited in the claims to be sufficient to locally deform the polymer layer thereby causing the tip to indent the surface of the polymer layer and leave a pit of a diameter of about 40 nm and surrounded by a ring of polymer substrate material raised above the polymer layer

   b. applying a second combination of energy and mechanical force via the tip to prerecorded pits of the polymeric surface to be erased,

5. Forming new pits overlapping pits representative of prerecorded data to be erased to substantially level the polymeric surface.

6. This is done by performing the write operation to overwrite pits to be erased with a greater density of new pits overlapping each other so that each new pit erases the immediately preceding pit.

7. The overlapping new pits merging with each other and the pre-recorded pit to be erased to substantially level the polymer surface to a level where the erased, pre-recorded bit is not detected as a data bit during a read operation.

All of these elements must be given weight to determine allowability.

The passage in Antes, at lines 5-11 of the Summary of the Invention of the object of the invention and describes embossing a small region of a thermoplastic substrate by applying sharply localized heat and pressure. This is too general to be a teaching or anticipation.

Column 5, lines 1-13, is also just a general statement of a desired result, and neither teaches nor suggests the specific claim elements, i.e.,

> applying a write current to the tip to heat the tip to a temperature of the order of 700 degrees centigrade level
>
> ---sufficient to locally deform the polymer layer thereby causing the tip to indent the surface of the polymer layer and leave a pit of a diameter of about 40 nm and surrounded by a ring of polymer substrate material raised above the polymer layer
>
> ---applying a second combination of energy and mechanical force via the tip to prerecorded pits of the polymeric surface to be erased.

The claims now recite a polymeric material, disclosed to be represented by poly (methyl methacrylate). Dougherty is limited is limited to "ferroelastic metals" which are very carefully enumerated at column 1, lines 6-34[1].

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[1] A ferroelastic material is one that exhibits:

1. A STABLE REMANENT STRAIN IN THE FERROELASTIC STATE WITH RESPECT TO THE PARAELASTIC STATE ABOVE THE FERROELASTIC Curie temperature;

2. A PARAELASTIC STATE WHERE THERE IS NO STABLE REMANENT STRAIN;

3. A FERROELASTIC Curie temperature at which a reversible thermoelastic (low temperature hysteresis) martensitic (diffusionless) transition occurs; and

4. A HYSTERESIS IN ITS STRESS-STRAIN CHARACTERISTICS, AND AN ANOMALY IN ONE OF THE ELASTIC CONSTANTS AT THE Curie temperature;

Certain alloys undergoing martensitic phase transitions, but whose ferroelastic character has not yet been ascertained, have been shown to have useful shape memory properties.

For example, in U.S. Pat. No. 3,652,967 a nickel-titanium wire is prestressed and heated to return it to its unstressed state. After several cycles such a wire can be used in control and work performing devices.

Saikai et al. describes specific circuitry for specific wave forms for a piezo-electric system.

Nakagawa is directed to a light recording (optical) medium where the thermal energy is applied as an incident light beam, without a mechanical pressure tip[2].

The art of record neither teaches nor suggests Applicants' claimed invention, and the claims are properly allowable to Applicants.

U.S. Pat. No. 3,558,369 describes metal alloys of the formula Ti Ni.sub.x Co.sub. 1-x and Ti Co.sub.x Fe.sub. 1-x wherein x is a number from 0 to 1 which are prestressed and heated to cause them to revert back to their original state. Such alloys are stated to be useful in control devices.

U.S. Pat. No. 3,450,372 describes a foldable antenna for a spacecraft vehicle which is unfolded by heat radiation. Such antennas are made of a nickel-titanium alloy which reverts back to its original state upon heating.
--- United States Patent 3,866,187 to Dougherty et al. February 11, 1975 for Method Of Recording And Reproducing Information In Ferroelastic Metals

[2] Its second object is to provide such an erasable light recording medium, in which a distinguishable threshold value appears in the light recording layer, thereby a pit is formed always with good reproducibility at a level of the predetermined input energy or higher, while at an energy level below the predetermined value, no pit is formed, thereby the region of the input light or temperature in which reproducibility of the pit formation fluctuates is narrowed, and in which at the same time the heat resistance is high and hence the deterioration in the S/N ratio of the information signal written in the pit during storage at high temperature is reduced, the surface of the pit or its vicinity does not undergo deformation due to the reading light, the S/N ratio of the written information signal is not deteriorated, further the writing sensitivity is high, and still further the S/N ratio of reading is extremely high. – Nakagawa, Column 2, lines 18-34

Erasing of information is effected by irradiating and heating the region covering the pit and its vicinity and having a diameter 3 times or more that of the pit diameter with a laser beam or an LED beam. In the heated region, the recording layer is melted to refill the pit, thereby the information is erased. In FIG. 5(B), 26B' shows the state where the pit has been filled again. – Nakagawa, Column 4, lines 20-26

Conclusion

Based on the above discussion, it is respectfully submitted that the pending claims describe an invention that is properly allowable to the Applicants.

If any issues remain unresolved despite the present amendment, the Examiner is requested to telephone Applicants' Attorney at the telephone number shown below to arrange for a telephonic interview before issuing another Office Action.

Applicants would like to take this opportunity to thank the Examiner for a thorough and competent examination and for courtesies extended to Applicants' Attorney.

Respectfully Submitted

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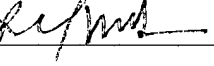
Signature: 

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